The RandomInt Class

Section 7.14

Robb T. Koether

Hampden-Sydney College

Wed, Oct 30, 2019

Robb T. Koether (Hampden-Sydney College)

The RandomInt Class

Wed, Oct 30, 2019 1 / 23

э

DQC

イロト イポト イヨト イヨト

Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class







Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class

3 Examples

4 Assignment

A B F A B F

- Many natural processes appear to be random.
 - Rolls of a die.

э

< ロト < 同ト < ヨト < ヨト

- Many natural processes appear to be random.
 - Rolls of a die.
 - Fluctuations in the stock market.

э

4 ∃ > < ∃ >

- Many natural processes appear to be random.
 - Rolls of a die.
 - Fluctuations in the stock market.
 - Spread of infectious diseases.

4 ∃ > < ∃ >

- Many natural processes appear to be random.
 - Rolls of a die.
 - Fluctuations in the stock market.
 - Spread of infectious diseases.
 - Test grades

4 ∃ > < ∃ >

- Many natural processes appear to be random.
 - Rolls of a die.
 - Fluctuations in the stock market.
 - Spread of infectious diseases.
 - Test grades
- Computer programs designed to simulate these processes must be able to simulate randomness.

Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class

3 Examples

4 Assignment

∃ ► 4 Ξ

- A random number generator is designed to produce a new "random number" each time the function is called.
- The numbers are not truly random, but pseudorandom.
- The algorithm is deterministic, but the output is so chaotic that it appears to be random.
- The output should also satisfy have number of statistical properties.

500

< 回 > < 回 >

- Basic random number generators produce one of two kinds of output.
- Integers:
 - In C++, rand() produces an integer from 0 to RAND_MAX, which is 32767.
 - In Java, Random.nextInt() will return an integer from -2147483648 to +2147483647.
- Floats:
 - On the TI-83, rand produces a real number between 0 and 1.
 - On the TI-83, randInt (a, b) produces a random integer from a to b, inclusive.

A B F A B F

Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class

3 Examples

4 Assignment

∃ ► < ∃ ►</p>

- Most random number generators use the linear congruential method.
- They use a seed, a multiplier, an offset, and a modulus.
- The formula is

seed = (*seed* × *multiplier* + *offset*) % *modulus*

• When the formula is evaluated, *seed* becomes the next random number as well as the new seed.

- Let the seed be 1, the multiplier 37, the offset 8, and the modulus 100.
- Then the next several "random" numbers are

$$(1 \times 37 + 8) \% 100 = 45,$$

 $(45 \times 37 + 8) \% 100 = 73,$
 $(73 \times 37 + 8) \% 100 = 9,$
 $(9 \times 37 + 8) \% 100 = 41.$

4 D b 4 A b

- The first 20 terms in the sequence are
 - 1 45 73 9 41 25 33 29 81 5, 93 49 21 85 53 69 61 65 13 89.
- Do they appear to be random?
- The next term is 1, giving this RNG a period of 20.

- Once the seed repeats a value, the entire sequence repeats.
- Since there are only a finite number of possible values for the seed, this must eventually happen.
- A good random number generator will have a very long period.

1) Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class

3 Examples

4 Assignment

∃ ► < ∃ ►</p>

- A RandomInt is an object that will produce random integers within a specified range.
- All integers in that range are equally likely.
- Each integer is (or appears to be) independent of all previous integers.
- For example, a RandomInt object could simulate rolls of a die by producing random integers in the range 1 to 6.

The RandomInt Data Members

int low; int high; unsigned int seed;

- int low Low end of range.
- int high High end of range.
- unsigned int seed Seed for the random number generator.

∃ ► < ∃ ►</p>

RandomInt Constructors

RandomInt(); RandomInt(int max); RandomInt(int min, int max); RandomInt(int min, int max, unsigned int s);

- RandomInt() Range is from 0 to RAND_MAX (32767).
- RandomInt (int max) Range is from 1 to max.
- RandomInt(int min, int max) Range is from min to max.
- RandomInt(int min, int max, unsigned int s) –
 Same as RandomInt(int min, int max), except that s is used to initialize the seed.

RandomInt Inspectors

int getLow() const; int getHigh() const;

- int getLow() const Returns low end of the range.
- **int** getHigh() **const Returns high end of the range**.

э

イロト イポト イヨト イヨト

RandomInt Mutators

void setInterval(int max); void setInterval(int min, int max); void setSeed(unsigned int s);

- **void** setInterval(**int** max) Sets range to 1 to max.
- void setInterval(int min, int max) Sets range to min to max.
- void setSeed(unsigned int s) Sets the seed to s.

Other Member Functions

int select();
void randomize();

- int select() Returns a random integer within the range.
- void randomize() Randomly sets the seed of the random number generator.

프 > - 프 >

Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class



Assignment

∃ ► < ∃ ►</p>

• The RandomInt Class

- randomint.h
- randomint.cpp
- RandomIntTest.cpp

Examples

- DieSimulator.cpp
- PokerHand.cpp

Random Number Generators

- Pseudorandom Numbers
- The Linear Congruential Method

2 The RandomInt Class

3 Examples



∃ ► < ∃ ►</p>

Assignment

• Read Section 7.14.

Robb T. Koether (Hampden-Sydney College)

The RandomInt Class

Wed, Oct 30, 2019 23 / 23

æ

590

<ロト < 回ト < 回ト < 回ト